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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|--------------------------------------|------------------------|
| 10/536,706 | 01/03/2006 | Stewart E. Hooper | YAMAP0983US | 9271 |
| 43076 | 7590 | 05/03/2007 | | |
| MARK D. SARALINO (GENERAL) RENNER, OTTO, BOISSELLE & SKLAR, LLP 1621 EUCLID AVENUE, NINETEENTH FLOOR CLEVELAND, OH 44115-2191 | | | EXAMINER MALEKZADEH, SEYED MASOUD | |
| | | | ART UNIT 1722 | PAPER NUMBER |
| | | | MAIL DATE 05/03/2007 | DELIVERY MODE PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--|-------------------------------|--|
| Office Action Summary | Application No. 10/536,706 | Applicant(s) HOOPER ET AL. | |
| | Examiner SEYED MASOUD MALEKZADEH | Art Unit 1722 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 January 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 8-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 May 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Art Unit: 1722

DETAILED ACTION

Priority

Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

An initialed and dated copy of Applicant's IDS form 1449 filed on May 27, 2005 is attached to the instant Office action.

Claim Objections

Claims 2-6 and 13-20 are objected to because of the following informalities: the word "and" before phrase of comprising is not appropriate. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Art Unit: 1722

Claims 1-6, 8-12, and 21-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Keller et al. (US 5,891,790)

Keller et al. (US 5,891,790) teaches a method of growing a p-type nitride semiconductor material by molecular beam epitaxy (See lines 49-52, column 2), the method comprising supplying bis(cyclopentadienyl) magnesium CP_2Mg during the growth process. (See lines 63-67, column 3)

Keller et al. ('790) further discloses the nitride semiconductor material is a P-type Gallium nitride (See lines 1-9, column 2). Also Keller et al. ('790) teaches supplying an ammonia gas during the growth process. (See lines 19-26, column 2)

Keller et al. (790) further teaches supply of ammonia gas (see lines 19-26 column 2), gallium (See lines 1-5, column 4) and CP_2Mg (See lines 56-67, column 3) to molecular beam epitaxy chamber, thereby to grow a layer of p-type GaN. (See lines 1-26, column 6)

Moreover, Keller et al. (790) discloses supply of ammonia gas (See lines 19-26 column 2), aluminum (See lines 56-67 column 3), gallium (See lines 1-5, column 4) and CP_2Mg to a growth chamber, thereby to grow a layer of p-type AlGaN. (See lines 16-28 column 5 and lines 1-8 column 6)

Keller et al (790) further teaches changing the supply rate of CP_2Mg during the growth of nitride semiconductor material. (See lines 1-15, column 4)

Keller et al. (790) also teaches the growth process is carried out at a temperature of between 800 °C to 1100 °C, but can be higher or lower.

Keller et al. ('790) further teaches a P-type nitride semiconductor material (See abstract and lines 49-54, column 2). Further, Keller et al. ('790) teaches a semiconductor device comprising a layer of a P-type nitride semiconductor material wherein the layer of nitride semiconductor material is a layer of p-type (Ga,Al)N. (See lines 15-28, column 5 and lines 1-8, column 6)

The prior art, thus, meet all the claim limitations, and therefore, Keller et al. ('790) anticipate the claims 1-12 and 21-23.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 13-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keller et al (US 5,891,790) in view of Barnes et al. (US 2004/0214412).

Keller et al ('790) teaches all the claim limitations of a method for growing a P-type nitride semiconductor material by Molecular Beam Epitaxy process as discussed above in the rejection. Further Keller et al ('790) teaches about the CP_2Mg pressure in the process. (See lines 29-45, column 3)

However, Keller et al (790) does not teach the claimed degree of pressure for supplied CP_2Mg , also does not teach the claimed degree of pressure for supplied elemental gallium during GaN growth process.

In the analogous art, Barnes et al. ('412) teaches a method of growing a P-type nitride semiconductor material by molecular beam epitaxy wherein magnesium is used as a P-type dopant. Barnes et al. ('412) further discloses Magnesium may be supplied to the growth chamber at a beam equivalent pressure of less than 1×10^{-7} mbar. (Paragraph 15). CP_2Mg is a Magnesium source to dope nitride material during growing a P-type nitride semiconductor. Also Barnes et al. discloses Gallium is supplied to the growth chamber of molecular beam epitaxy at a beam equivalent pressure greater than 1×10^{-8} mbar and less than 1×10^{-5} mbar.

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify Keller et al ('790) by providing a supplying pressure of less than 1×10^{-7} mbar for CP_2Mg , and providing a supplying pressure of greater than 1×10^{-8} mbar and less than 1×10^{-5} mbar for elemental gallium during GaN growth

Art Unit: 1722

process in order to provide a p-type GaN that has a high concentration of free charge carriers and eliminates the need to activate magnesium dopant atoms or gallium atoms by annealing or irradiating the material, as suggested by Barnes et al. ('412).

Claims 19 and 20 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Keller et al (US 5,891,790) in view of Hooper et al. (US 2002/0117103).

Keller et al ('790) teaches all the claim limitations of a method for growing a P-type nitride semiconductor material by Molecular Beam Epitaxy process as discussed above. Further Keller et al ('790) teaches about the CP_2Mg pressure in the process. (See lines 17-45, column 3). Further Keller et al teaches the functional equivalency of Indium and aluminum (See lines 56-62, column 3). Therefore the degree of pressure for supplied elemental Ga and In in InGaN growth process is comparable to the degree of pressure for supplied elemental Ga and Al in AlGaN growth process.

However, Keller et al does not teach the claimed degree of pressure supplied for elemental gallium and elemental aluminum during AlGaN growth process.

In the analogous art, Hooper et al (2002/0117103) teaches a method of growing an (In, Ga)N layer structure by molecular beam epitaxy. Hooper et al ('103) further teaches the beam equivalent pressure of indium and gallium supplied to the growth chamber may be equal to or greater than $1 \times 10^{-8} \text{ mbar}$ and less than $1 \times 10^{-4} \text{ mbar}$. (See paragraphs [0027] and [0028]).

It would have been obvious to one of ordinary skill in the art at the time of applicant's invention to modify method of Keller ('790) by providing a supplying pressure of less than $1 \times 10^{-8} \text{ mbar}$ for elemental gallium and elemental aluminum during AlGaN

Art Unit: 1722

growth process in order to prevent from low growth rate of nitride layer and obtaining a high-quality growth of the layers, as suggested by Hooper et al. ('103).

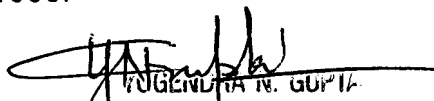
Remarks

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Masoud Malekzadeh whose telephone number is 571-272-6215. The examiner can normally be reached on Monday – Friday at 8:30 am – 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra N. Gupta can be reached on (571) 272-1316. The fax number for the organization where this application or proceeding is assigned is 571-272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance form a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

SMM


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